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# Market restrictions on the lifting and transportation equipment production

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**Abstract.** Over the past few decades, the trends of globalization and the markets expansion have been fundamental in the Russian and world economies. Such economic structure requires a large volume and range of transportation, the storage systems presence, the transported objects distribution. Logistics centers become an integral part of the economic development both for the regions and the country as a whole. Logistics centers, in turn, need specialized equipment that allows the most efficient use of existing storage areas. Reach truck is one of the most commonly used equipment in large A and A + warehouses. The article presents the estimating market restrictions method when the equipment cost determining taking into account the characteristics of the designed facility and the main competitors represented on the market. The method peculiarity is taking into account the technical and consumer characteristics of the investigated object, their comparison with the competitors' parameters. Based on this comparison, the possible product price is determined. The proposed technique allows to optimize equipment configuration and price depending on the consumers' needs. The proposed evaluation algorithm was tested on complex technical equipment (reach truck), but it should be noted that the proposed methodology is universal and can be applied to any technical object.

## 1. Introduction

Logistics services over the past 20-30 years have been developed at a huge pace. No matter what developed transport system the region or the state possesses, the modern economy cannot exist without logistical (transshipment, sorting) centers. According to Knight Frank analyses, the total supply of quality warehouse space in Russia amounted to 24.9 million m<sup>2</sup> (the results of 2018), of which 57% or 14.2 million m<sup>2</sup> are located in the Moscow region, 13% or 3.3 million m<sup>2</sup> - in St. Petersburg and the Leningrad region, and 30% or 7.4 million m<sup>2</sup> - in the regions of Russia. Such large warehouse spaces require equipment to ensure their effective use. One type of such equipment is reach truck. The peculiarity of this equipment is the cargo lifting to high rack within the warehouse. The past few years (including sanctions) situation has led to the fact that import substitution has become one of the most important conditions for the economy development [1-3]. Thus, modern industrial enterprises need a mechanism to assess the competitiveness of manufactured products, market restrictions on the production and promotion of new products.

The product price is one of the most important competitiveness parameters [4, 5]. Thus, the product pricing mechanism must take into account a number of factors, such as production costs, product quality, consumer satisfaction, etc. There are many approaches to determining the product price. The



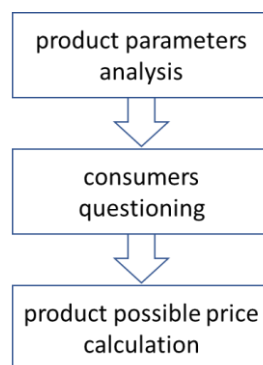
most commonly used groups of pricing methods are cost methods, market, regulatory and parametric [6-9].

Each of the pricing methods groups has its own advantages and disadvantages [10, 11]. For example, cost pricing methods do not allow to take into account market conditions, but these methods are simple, understandable and verifiable [6, 7]. Market methods, on the contrary, takes into account the competition level, the competitive goods parameters, but does not consider production costs [8,12-14]. Regulatory parametric methods require a comparison base.

Thus, the possible price determining algorithm development for a technical facility seems quite relevant [9, 15]. The authors conducted a statistical data study, on the basis of which a competitive price calculating algorithm for lifting and transportation equipment (reach truck) used in large logistics centers was proposed.

## 2. Research method

The proposed pricing method includes elements of methods taking into account competitor prices and rating methods. The proposed technique consists of several stages (Figure 1).



**Figure 1.** The methodology stages.

Consider in detail each step of the proposed method.

Stage 1. Product parameters analysis. At this stage, it is planned to study the technical and consumer characteristics of the product. The b2b market consumer decides to buy technical products according to the list of factors and parameters, in addition to the technical characteristics of the product repairability, aesthetic qualities, brand, etc. are taken into account. Thus, the purpose of this step is to create a list of technical and consumer characteristics important to the product user.

By technical characteristics, we mean the product purpose characteristics. Most often, a set of these characteristics is known and generally accepted. For example, for lifting equipment, this will be: lifting speed, lifting cargo weight, speed, dimensions, fuel type, etc.

The consumer characteristics are a set of parameters that are not related to the technical characteristics, but affect the product purchase decision. Such characteristics can include: repairability, convenience and cost of maintenance, ergonomics, safety, aesthetic qualities, environmental friendliness, manufacturer's brand, etc. The list of these parameters can be changed based on interviews with potential consumers.

Based on the analysis performed, the first level parameters groups are formed. During the study, the following first level parameters were formed for the reach truck: technical characteristics (lifting capacity, lifting height, etc.), maintenance of equipment, repairability, ergonomics, safety, aesthetic qualities, brand of the manufacturer. These characteristics are laid out into specific parameters important for maintenance personnel during operation and can be identified by interviewing experts. As part of the study, such parameters were assigned a designation - a second-level product parameter.

Stage 2. The stage involves collecting information from consumers and manufacturers. This stage is based on the analysis of open information about technical characteristics (technical characteristics) of competitors, which can be collected from commercial offers and advertising booklets. And also on

the basis of a potential consumers' questionnaire in order to identify consumer characteristics. The questionnaire is drawn up in such a way that the respondent notes the presence/absence of a parameter in the operated equipment by setting 1 (if presence) or 0 (if none).

Stage 3. Based on the collected statistical information, each characteristic of the studied object significance is calculated, which makes it possible to calculate the possible price on the basis of the different manufacturers products parameters comparing. The results of the questionnaire and the information received from open sources are processed using the following algorithm:

1. The first level parameter groups significance determine.

In the questionnaire, respondents are asked to place the significance between the declared first level parameters within 100% (the sum of the parameters significance should be 100%). For further analysis, the average value for each parameter is taken.

2. determining the second level parameters significance

The second level parameters significance is calculated by the formula:

$$Z_{ji} = Z_j * \frac{1}{n} \quad (1)$$

where:

$Z_{ji}$  is the significance of the i-th parameter of the j-th group;

$Z_j$  - significance of j-th group of parameters (results of the first stage);

$n$  - is the number of parameters in the j-th group.

3. Determine the point score for the specific product

For a particular product, the points are summed according to the parameters included in the analyzed package and the total score for the product is calculated. Since the second level parameters structure includes all consumer characteristics collected according to the questionnaire results, the total score for the product will be less than 100%.

4. Define the price structure and possible price changes when the parameter set is changed

Having received the total score for the article, the cost of 1 point can be find by the formula:

$$1p = \frac{P}{T} \quad (2)$$

where:

$1p$  - one-point cost;

$P$  - the product price in a certain complete set;

$T$  - total point of the product

The price must then be determined taking into account the presence/absence of parameters compared to competitors.

Calculation procedure:

- if the parameter is not available (unlike a competitor), the score (points) is subtracted;
- if the parameter is available (unlike the competitor), the score (points) is added;
- if the parameter is available of the tested object and the competitor the score (points) can be taken from the previous part (step 3).

All points are summed up to obtain the total score of the investigated object and the competitor comparison.

The investigated object possible price the is calculated by the formula:

$$P_{o/c} = \frac{P_b * P_c}{P_{\Sigma}} \quad (3)$$

where:

$P_{o/c}$  - the estimated price of the base product compared to the competitor;  $P_b$  - the competitor's product base price;

$P_c$  - competitor points sum

$P_{\Sigma}$  - points sum of the investigated product compared to the competitor

### 3. Research results

The investigation was carried out for hoisting equipment operating in a warehouse (reach truck).

During the investigation, focus group respondents were asked to determine the significance of 8 groups of reach truck parameters. According to consumers answers technical characteristics (35.6%), equipment maintenance (14.8%) and repairability (13.1%) are the most important in choosing a reach truck.

The second level parameters significance was determined according to 60 parameters. Parameters were selected both by their availability in publicly information (company booklets) and by the consumers' survey results. Potential consumers were asked to select the parameters necessary in the basic model of the reach truck. The table 1 contains excerpts from the general analysis, the significance is calculated according to formula 1.

**Table 1.** Reach truck base model popular configuration.

Reach truck parameters	Base model	Option	Parameters significance
<b>Equipment maintenance</b>			0,1475
Easy battery removal	+		0,0738
filters and lubrication points availability	+		0,0738
<b>Repairability</b>			0,1313
Possibility of hydraulic equipment repair without the unit complete replacement	+		0,0328
Availability (for repair and maintenance) of the most wear-prone units	+		0,0328
.....			0,0657
<b>Ability to integrate the reach truck into the enterprise information system</b>			0,0188
Having an operating system that supports remote access		+	0,0038
Presence of transmitter (e.g. Wi-Fi)		+	0,0038
....			0,0112
<b>aesthetic qualities</b>			0,0500
rear view mirror presence		+	0,0013
steering console leader adjustable	+		0,0013
Ability to start the reach truck from the PIN		+	0,0013
Mast lateral shift possibility	+		0,0013
.....			0,0448
<b>Safety</b>			0,1750
Three independent braking systems		+	0,0097
Locking of machine start with unlocked battery	+		0,0097
.....			0,1556
<b>Total</b>			<b>1</b>

Three competitors with the closest technical parameters were selected for comparison. Considering that each product in the price structure contains a premium for brand and aesthetics, in the calculations it is proposed to "clean" the prices.

**Table 2.** Price according to commercial offers.

№	Model	Price, RUB	Price without the brand and aesthetics, RUB.
1	Still FM-X 17	2 648 300	2 327 194
2	Linde R17X/116-03	4 026 765	3 538 520
3	Jungheinrich ETV 216	3 251 800	2 857 519

Based on the product parameters conformity analysis (according to the customers' opinion), each model was evaluated in points. The total score for the models is given in the table, and the table 3 also shows one-point cost calculation (calculated by the formula 2).

**Table 3.** One-point cost calculation.

№	Model	Price without the brand and aesthetics. RUB.	Total score. %	ne-point cost calculation. RUB.
1	Still FM-X 17	2 327 194	76.35	30 480.6
2	Linde R17X/116-03	3 538 520	75.91	46 614.68
3	Jungheinrich ETV 216	2 857 519	75.35	37 923.28

Next, the studied track configuration was evaluated. Based on the assessment, the studied object score is determined compared to each competitor (Table 4). The evaluation was carried out according to the algorithm described in paragraph 4 of the methodology third stage.

**Table 4.** The studied object configuration estimation in comparison with competitors, in shares.

Reach truck parameters	Still FM-X 17	Linde R17X/116-03	Jungheinrich ETV 216
Technical parameters	0.35625	0.35625	0.35625
Equipment maintenance	0.1475	0.1475	0.1475
Repairability	0.13125	0.13125	0.13125
Ability to integrate the reach truck into the enterprise information system	0	0	0
Aesthetic qualities	0.00125	0.0025	0.01
rear view mirror presence	-0.00125	-0.00125	0
steering console leader adjustable	0.00125	0.00125	0.00125
Ability to perform multiple actions at the same time (e.g. mast extension and fork lifting)	0.00125	0.00125	0.00125
Dampened operator workstation	0.00125	0.00125	0.00125
Sum of the other points	-0.0025	0.005	0.00625
Total score	0.71401	0.71526	0.73248
Total score. %	71.4	71.52	73.24

The ponticular prices were calculate for the investigated object (reach truck) in accordance with the parameters significance analysis (Table 5).

**Table 5.** Estimated price range for the investigated object (reach truck).

№	Model	Price without the brand and aesthetics . RUB.	Total score.%	Total score for the investigated object .%	Investigated object price in comparison with competitors. RUB.
1	Still FM-X 17	2 327 194	76.35	71.4	2 176 315
2	Linde R17X/116-03	3 538 520	75.91	71.52	3 333 882
3	Jungheinrich ETV 216	2 857 519	75.35	73.24	2 777 501

Thus, we get a possible «price corridor» for the reach truck with specified technical characteristics from 2.1 million to 3.3 million rubles.

#### 4. Discussion

The proposed methodology can be used to estimate the price of any object. A feature of this methodology is the result validity, the ability to evaluate the investigated object in comparison with competitors. Another important advantage is the variability of the result. According to the calculation results, "price corridor" has been received, and not a specific figure (possible price). The "price corridor" gives freedom to choose and justify the price according to the competitiveness level (based on prices and consumer characteristics) compared to the main competitors.

However, this methodology also has a number of drawbacks that reduce its attractiveness and wide use. Such disadvantages include, first, it is necessary to collect a lot of information, often technical characteristics. Second, subjective evaluation of the lower level parameters significance. If the upper level of parameters is estimated according to the consumer questioning analysis, then the lower level cannot be estimated based on the questioning. The first step of the described model involves conducting surveys or focus groups with potential consumers, which also complicates the process of proposed model implementing.

#### 5. Conclusion

Competitive constraints must be taken into account when deciding whether to produce or market with a new product. The proposed methodology allows assessing market restrictions, primarily expressed in the product price. However, it should be noted that the proposed methodology allows evaluating the technical parameters of the compared objects. Based on this comparison, a model of competitiveness and object price determination is built. The proposed approach allows you to optimize the configuration of an industrial product in accordance with the consumers requirements. The proposed technique can be used for any technical object.

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